

Montana Driver Education and Training

Strategies for Managing Risk with Vehicle and Highway Designs Part II



Source: FHWA

Standards and Benchmarks

1. Laws and Highway System

- a. know the laws outlined in the Montana Driver's manual
- b. understand the laws outlined in the Montana Driver's manual
- c. consistently demonstrate knowledge and understanding by responsible adherence to highway transportation system traffic laws and control devices

2. Responsibility

- a. recognize the importance of making safe and responsible decisions for owning and operating a vehicle
- d. develop habits and attitudes with regard to responsible driving

6. Risk Management

- a. understand driver risk-management principles
- b. demonstrate driver risk-management strategies
- c. develop driver risk-management habits and attitudes

7. Lifelong Learning

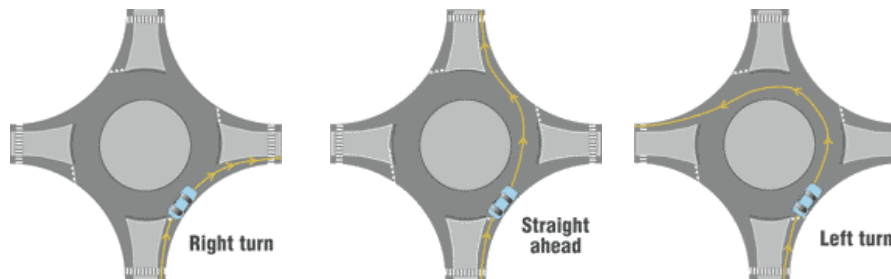
- a. understand past, present and future vehicle and roadway design, and driving cultures
- b. describe past, present and future motor vehicle laws
- c. understand benefits of a lifelong learning approach to driving
- e. identify opportunities for lifelong education in driving

Highway Designs to Reduce Crashes

Roundabouts



- Research indicates roundabouts can be safer and more efficient than conventional intersections
- Injury and fatal crashes can be reduced 20 percent for traffic flows of double-lane roundabouts and by as much as 70 percent for traffic flows of single-lane roundabouts
- Roundabouts also mean less delay for motorists as opposed to conventional stop- or signal-controlled intersections

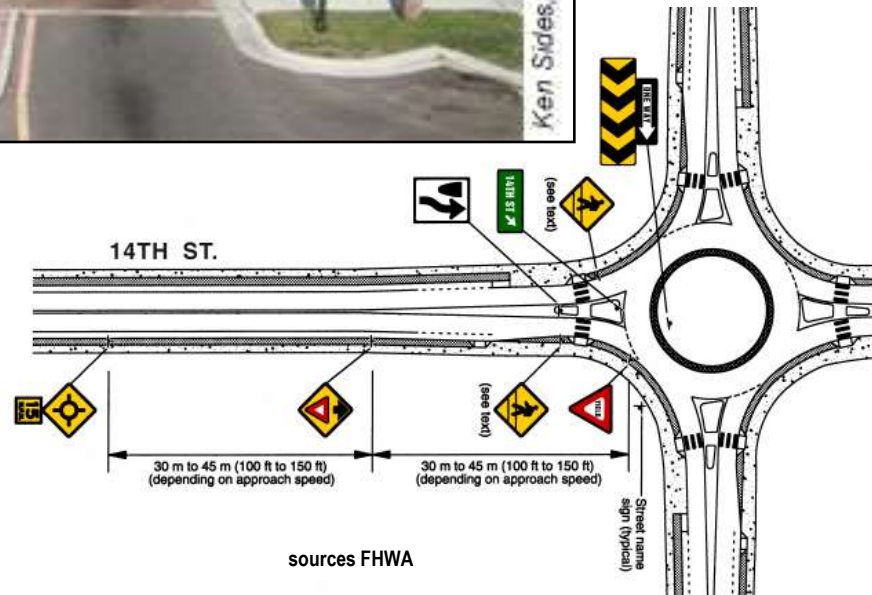


Source IIHS and MUTCD

Roundabouts



Ken Sides, City of Clearwater, FL

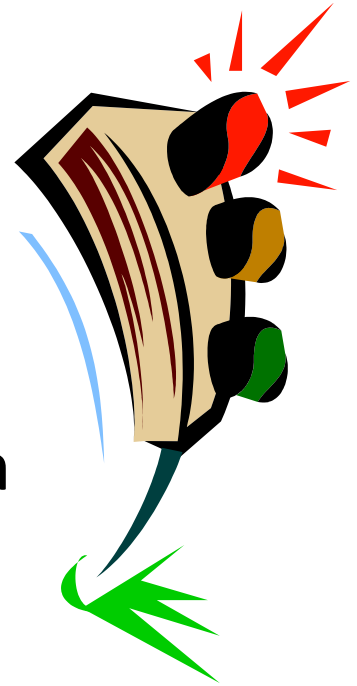


sources FHWA

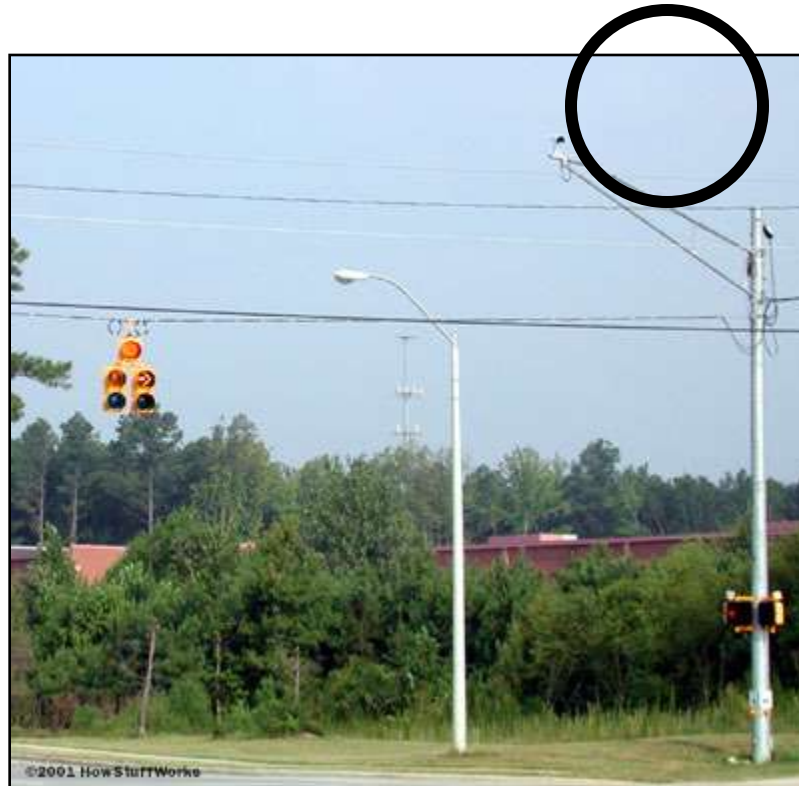
Highway Designs to Reduce Crashes

Red light running

- One of the primary causes of crashes
- Running red lights has an alarmingly high injury rate of 45%
- This type of behavior may be reduced through roadside surveillance devices, such as red light cameras, roadside speed inspection devices, and onboard automatic vehicle control systems, that can take over part of the driving tasks before a crash occurs



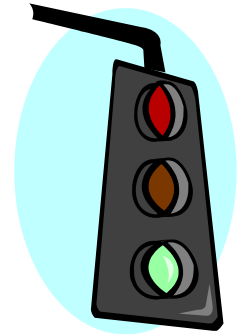
Red Light Running



Highway Designs to Reduce Crashes

Intersection controls

- The latest controllers for traffic lights use computers capable of multiple timing patterns and remote communications
- A laptop computer can control a multitude of signals from virtually any location
- Agencies can install magnetic, microwave (or radar), acoustic, or video detection technologies above the roadway and are not affected by adverse weather or typical utility and roadway work



Intersection Controls



Source <http://www.tfhrc.gov>

Highway Designs to Reduce Crashes

Pedestrian crossing

- Pedestrian protection systems are creating safer intersections by increasing signal cycle time for pedestrians still in the crosswalk
- In some communities a numeric countdown sign is activated when the orange hand begins flashing
- Such signals enable pedestrians to make more informed decisions before crossing



Pedestrian Crossing



These three photographs show how increasing the luminance levels of overhead lights and the amount of vertical illumination can reveal a pedestrian who was nearly invisible under low-lighting conditions

Pedestrian Crossing

In-pavement lighting,
illuminated pushbutton
pedestrian signals, and
automated detectors aid
pedestrians and drivers



Highway Designs to Reduce Crashes

Intersection turn lanes

Well-defined turn lanes have increased the safety of all roadway users



Highway Designs to Reduce Crashes

Retro-reflective traffic signs

The Federal Highway Administration is establishing minimum requirements for retro-reflectivity — a measure of the amount of light returned to its source — for traffic signs and pavement markings



Highway Designs to Reduce Crashes

Pavement drop offs

- A pavement edge is where there is a drop off of more than four inches and the angle of the road to the shoulder is 90 degrees is considered unsafe
- Once a vehicle has crossed from a paved surface onto an unimproved shoulder, the driver's reaction often is to overcorrect to get back on the road
- In the process, the rear wheel may catch on the shoulder edge and spin the vehicle around



Highway Designs to Reduce Crashes

Pavement drop offs

- In many instances, drivers attempting to return to the road often veer into the adjacent lane, cross into opposing traffic, or leave the opposite side of the roadway and become a statistic
- A temporary safety edge is used until the shoulders can be reconstructed



Highway Designs to Reduce Crashes

Median islands

- Raised median islands often are associated with traffic calming and speed reduction but they also help separate traffic going in the opposite direction
- A raised median island can limit left-turn access while protecting motorists from the potential hazards posed by landscaping and other fixed objects in the median



Highway Designs to Reduce Crashes

Median barriers

- Median barriers are designed to prevent vehicles from crossing the median and going into opposing lanes
- There are different types of median barriers (concrete, steel, and cable) and all are designed to safely stop or redirect a vehicle that enters the median



Source: FHWA

Highway Designs to Reduce Crashes

Run off the road crashes

- Improved signage on rural roads is effective in reducing run-off-the-road-crashes
- Chevron signs delineate curves and call attention to a new intersection alignment



Highway Designs to Reduce Crashes

Rumble strips

- Rumble strips are raised or grooved patterns constructed on the roadway's shoulder and when tires pass over them produce a rumbling sound and cause the vehicle to vibrate
- The noise and vibration produced by the strips are effective alarms for drivers who have drifted from their travel lane onto the shoulder
- Rumble strips can reduce run off the road crashes by 15 to 70 percent, which would lead also to a reduction in the number of injuries and fatalities



Source: FHWA

Rumble Strips



Highway Designs to Reduce Crashes

Guardrails

- Without guardrail systems, the carnage on the nation's roadways would be even more gruesome than the 42,000-plus victims that automobile crashes claim each year
- Crashes involving vehicles that run off the road account for roughly one-third of those 42,000 annual deaths
- The federal government (FHWA) recently enacted more stringent guidelines governing crash barriers along federally funded highways

Guardrails



Source: FHWA



Highway Designs to Reduce Crashes

Driver information systems

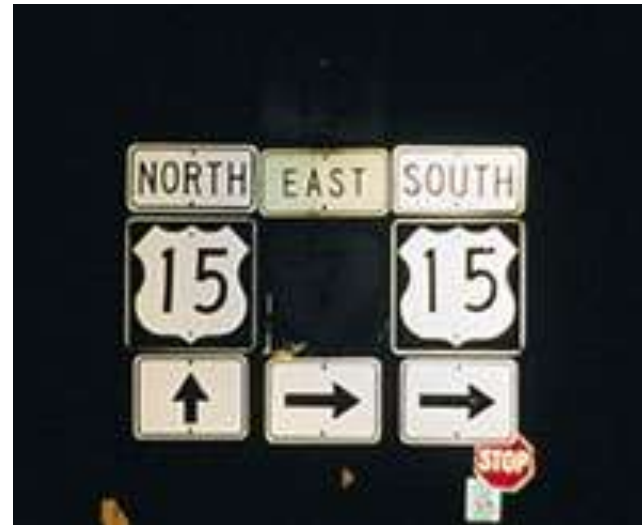
- To enhance driver awareness of traffic conditions, this system provides traffic and weather information collected by roadside devices
- The information is channeled through in-vehicle equipment and roadside information displays



Highway Designs to Reduce Crashes

Vision enhancement systems

In addition to in-vehicle vision enhancement devices, improvements to roadway infrastructure, such as infrared reflective lane-edge marking, can improve a driver's vision



Source: FHWA

Highway Designs to Reduce Crashes

Intelligent speed control system

This system gathers information on the current speed limit from a roadside speed control system and then provides the information through in-vehicle devices and warns the driver of a speed violation



Intelligent Speed Control System



Highway Designs to Reduce Crashes

Train-detecting sensors

- Located at highway-rail intersections can detect oncoming trains and warn drivers via variable message signs
- Gate running accounts for 22 percent of crashes and 26 percent of fatalities; second train warning signs and law enforcement surveillance detectors can deter drivers from entering an intersection when a train is approaching
- In-vehicle information devices also can improve driver awareness of highway-rail intersections
- Large trucks, transit vehicles, and school buses equipped with these devices are serving as pioneers in several pilot projects

Train-Detecting Sensors

In-vehicle warning systems that are triggered by roadside devices such as this one for a railroad crossing may provide another level of security for the driving public.



Vehicle Designs for Safer Cars

- With safety a growing concern for car shoppers, more and more manufacturers are using their crash test ratings in ads to pull in buyers
- According to the Insurance Institute for Highway Safety (IIHS) if you were traveling in a car that was rated "Poor" and got hit by a car rated "Good," you would be three times more likely to be killed in the collision (if there was a fatality) than the driver of the "Good" car



Vehicle Designs for Safer Cars



Vehicle Designs for Safer Cars

Collision avoidance systems

- Collision Avoidance systems are like high-tech cat whiskers that are designed to help a driver gauge proximity to other drivers or objects
- These systems target avoidance of several kinds of roadway crashes, such as rear-end collisions, road departure collisions, lane change and merge collisions, and intersection collisions
- These systems obtain traffic information such as acceleration, relative speed, and distance from other vehicles through sensors in the vehicle, then analyze the likelihood of a collision, and give the driver warning of a high probability of collision

Collision Avoidance Systems



Source: <http://pda.physorg.com>

The warning is projected on the windshield

Vehicle Designs for Safer Cars

Driver status and performance monitoring systems

- Like an attentive copilot, an onboard driver status and performance monitoring system keeps tabs on the driver
- Using sensors to monitor driver performance and psychophysical status, the system identifies dangerous driver conditions such as drowsiness and distractions and then provides an appropriate warning signal



Vehicle Designs for Safer Cars

Vision enhancement systems

- Reduced visibility is a significant factor in 42 percent of all vehicle crashes
- Lighting and weather conditions such as glare, dawn, dusk, dark, artificial light, rain, sleet, snow, and fog can cause reduced visibility
- In-vehicle vision enhancement services through onboard systems that use infrared radiation from pedestrians, animals, and roadside features to give drivers an enhanced view of what's ahead

Vision Enhancement Systems



Vehicle Designs for Safer Cars

Automated collision notification systems

- In-vehicle collision notification systems, such as rural mayday systems, send out notification signals automatically when a crash occurs
- By reducing the time between the occurrence of a collision and notification of emergency service providers, automated collision notification systems can help emergency responders get to the scene faster and reduce the consequences of a crash



Automated Collision Notification Systems

Integrated Vehicle-Based



Safety Systems

Source: NHTSA

Vehicle Designs for Safer Cars

Innovative belt reminder systems

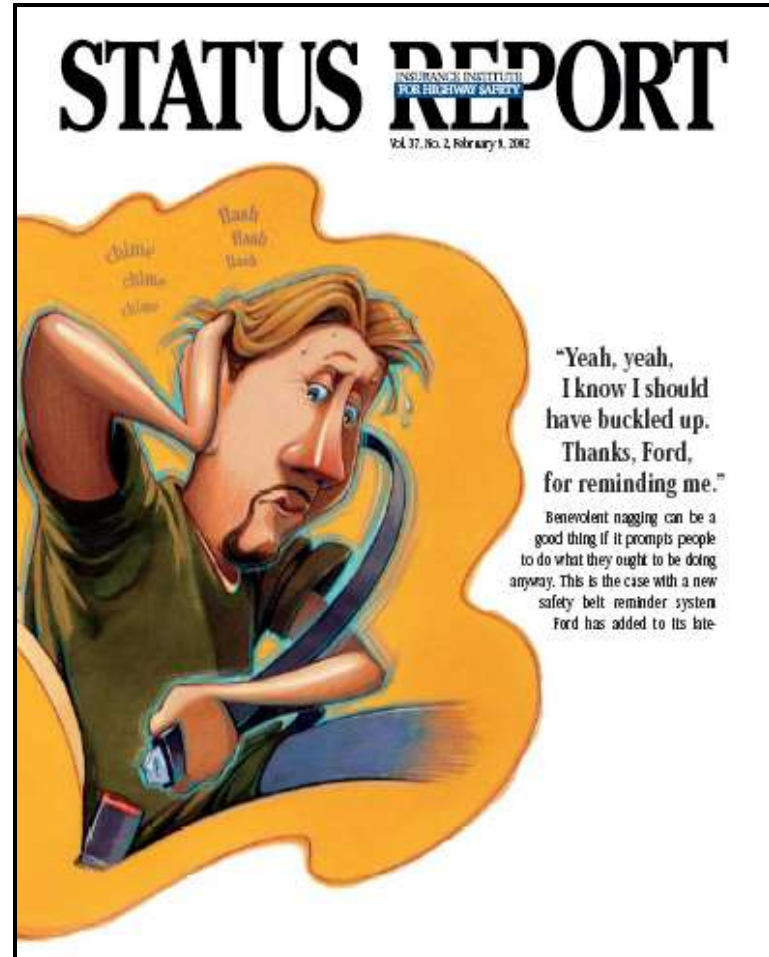
- All vehicles are required to have a four- to eight-second reminder for the driver that appears as a dashboard warning light (often designed as a person in a safety belt) and also makes a buzzing or bell-like sound
- Some manufacturers have voluntarily installed innovative systems that go beyond the federal standard and provide additional warnings when occupants are not using safety belts
- These systems have visual and/or audio warnings to remind drivers to buckle up; a system to warn passengers is not yet available
- Some of these systems also sense how fast the vehicle is traveling, and increases the frequency of the warning

Innovative Belt Reminder Systems

Insurance Institute
for Highway Safety

Status Report

<http://www.highwaysafety.org/>

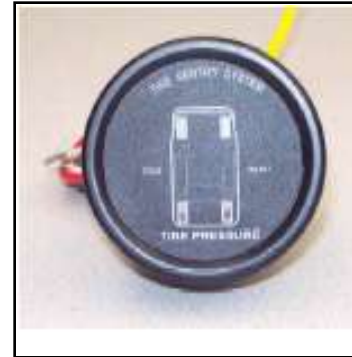


Vehicle Designs for Safer Cars

Tire Pressure Monitoring System (TPMS)

- The Tire Pressure Monitoring System (TPMS) uses a dashboard warning light to alert the driver when one or more of a vehicle's tires is significantly underinflated – a leading cause of tire failure
- A tire is considered significantly underinflated when its pressure is 25 percent below the vehicle manufacturer's recommended tire inflation pressure
- Beginning with the 2006 model year, manufacturers will begin phasing TPMS into their new vehicles
- By September 1, 2007, all new vehicles will have TPMS

Tire Pressure Monitoring System



Vehicle Designs for Safer Cars

Advanced (frontal) air bag systems

- Beginning with 2004 vehicles, advanced air bag systems are required in a portion of each manufacturer's production
- By September 1, 2006, all new vehicles will have advanced (frontal) air bag systems
- Advanced air bag systems are a next-generation frontal air bag system designed to further reduce the likelihood of serious injury or death to occupants, whether adults or children, who may be too close to the air bag when it deploys

Advanced (Frontal) Air Bag Systems



Source: Chrysler Corporation

Vehicle Designs for Safer Cars

Side Air Bags (SABs)

SABs offer additional protection to two main areas of the body — the head and the chest — during side impact crashes



Source: <http://www.safeprogram.com>

Upper Door Panel Intrusion

Serious Injuries

Head

- Door Post

Chest

- Door and
- window sill

Abdomen

- Door and
- arm rest

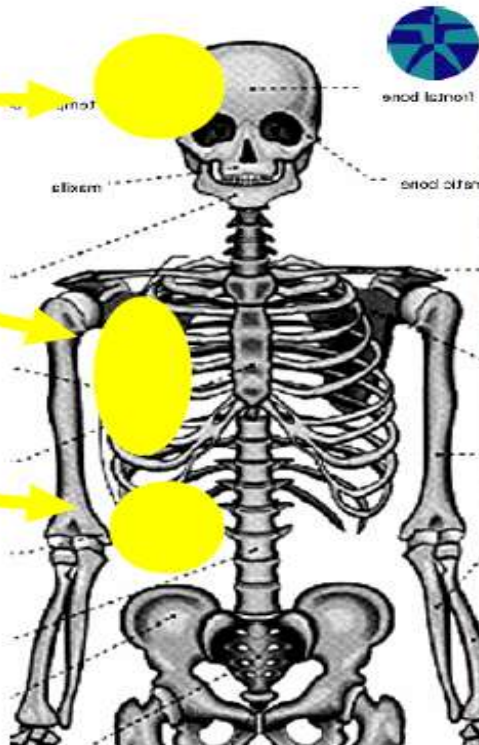


Photo & graphic courtesy of - Rob Kaufman BS Crash Investigator

Vehicle Designs for Safer Cars

Rollover air bags

- Ejection is the most common source of injuries and fatalities in rollover crashes
- With input from a separate rollover sensor, some curtain SABs can be designed to also deploy as *rollover* air bags in the event of a rollover—rollover air bags stay inflated longer to help keep you inside the vehicle
- Rollover air bags, along with properly worn safety belts, reduce the risk of injury and ejection



Rollover Protection



Source Ford Motor Co.

COLLISION TYPES

- According to the Federal Highway Administration as of October 2004 there were nearly 200,000,000 licensed drivers in the United States
- Nearly 70% of our population can legally drive
- Of this driving population not all are good drivers which can explain why there were over seven million car crashes in 2004



COLLISION TYPES

The collision that usually causes the least amount of damage is called a **low speed impact crash**

- A low impact crash is generally defined as one that takes place at speeds under 10 mph
- A motor vehicle might be built to take a 5 or 10 mph crash but your body's soft tissue can't
- The neck and back are the areas usually most affected
- The chest and ribs can also sustain injury



COLLISION TYPES

A second type of impact is a side impact

- These collisions are exactly what the name suggests—one car collides with another from the side
- Side impact collisions cause the occupant's head and body to be forced from side to side
- If air bags are not part of the vehicle there is really nothing stopping the occupants from taking the full impact of the crash



Source: Oregon Department of Transportation

Side Impact

These types of accidents are quite serious—in 2000, side impact collisions made up 21% of all fatal automobile accidents and 25% of all non-fatal automobile accidents



Source: NHTSA

COLLISION TYPES

Frontal and rear collisions allow a limited buffer zone

- That buffer zone is the front section of your car with the front bumpers and the engine or the rear bumper and the trunk
- If the oncoming vehicle collides squarely with the second car in the driver's or passenger's door the vehicle and person or persons inside must absorb the full force of the impact
- Frontal collisions cause injuries that are much more severe than those in a low impact collision



COLLISION TYPES

- The government, insurance agencies and vehicle manufacturers have tested and researched side impact collisions
- The result of these tests was the development of side airbags
- If they deploy properly they can save a life—unfortunately side airbags are not standard on all cars but are becoming more common



Source: Volvo Motors

COLLISION TYPES

Rollover crashes are also a type of impact collision

- Most rollovers occur when a vehicle runs off a road and turns over on its side or continues to flip over more than once
- Rollover collisions might involve one vehicle or more and are very serious crashes that result in a high number of fatalities
- Injuries in a rollover accident can be quite serious
- It is believed that the best way to prevent or limit rollover injuries is to use the seat belt and avoid aggressive or erratic driving
- Taking a turn at a high rate of speed, over-correcting a swerve or leaving the even roadway are all conditions that can lead to a rollover

Rollover Crashes (Cont.)

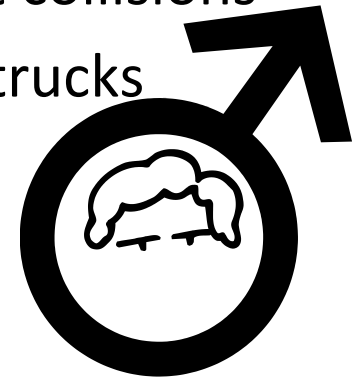
- The worst injuries will occur to a passenger that is not wearing a seat belt and is ejected from the vehicle
- The injuries can be head, soft tissue, neck, chest, arms, legs, ribs and internal bleeding
- One would be lucky to come out of a rollover with only cuts, scrapes and bruises



Males vs. Female Drivers

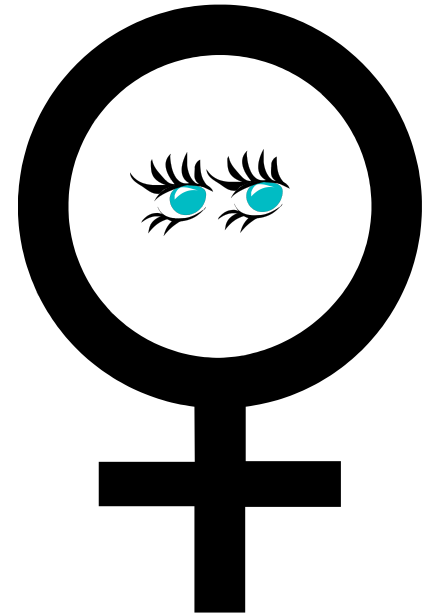
A study completed by the Federal Highway Administration (FHWA) in Hawaii compared males to females in collisions; males were:

- 3.56 times more likely to be involved in alcohol or drug related crashes
- 2.08 times more likely to be involved in speed related collisions
- 1.44 times more likely to be unbelted
- 1.34 times more likely to be involved in head-on collisions
- 1.5 times more likely to be involved in night collisions
- 2.14 times more likely to be driving pickup trucks
- 1.27 times more likely to be killed

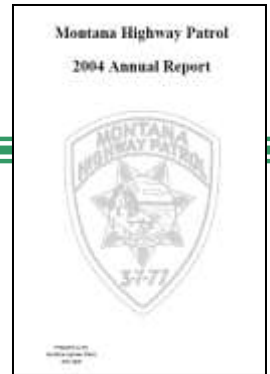


Males vs. Female Drivers (Cont.)

- The results also show that females are slightly more likely than males to be involved in collisions which involve “failure to yield,” as well as being more likely to be involved in collisions which involve left turns, being stopped in traffic, or slowing or stopping
- Females are also more likely than males to be involved in collisions in urban areas and at intersections



Montana 2010 Collision Facts



Each year, the Montana Highway Patrol prepares a report of all crashes investigated by Montana Law Enforcement

**20,518 crashes
Reported**

- ✓ **One crash every
26 min.**
- ✓ **56 crashes (avg.)
per day**
- ✓ **19 persons injured
(avg.) per day**

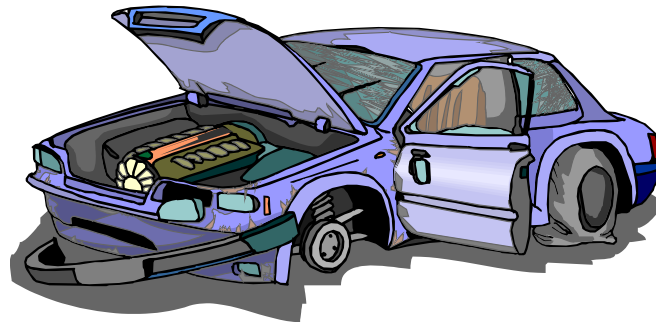
**189 fatalities in
161 fatal crashes**

- ✓ **One fatality every 46 Hours**
- **6,992, injuries in 5,031 injury
crashes**
- ✓ **One injury every 104 min**
- **15,326 property damage only
crashes**
- ✓ **One property damage only
crash every 34 min**

Control the Consequences of a Crash

Never risk more than you can afford to lose

- Do not risk a lot for a little
- Consider the odds and your situation
- Distinguish between elements of driving that are beyond a driver's control (actions of other drivers, weather, pedestrians, etc.) from those they do control (speed, use of alcohol, wearing safety belts, obedience to traffic signals, etc.)
- In dealing with risk, try to use those things you can control to help deal with those things that you can't

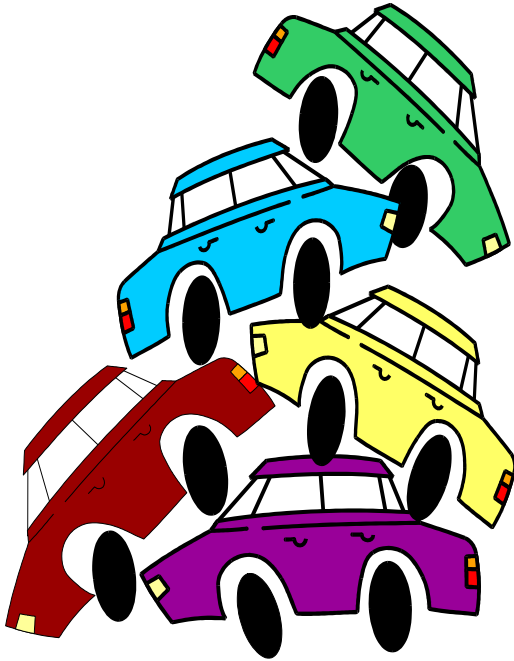


Control the Consequences of a Crash



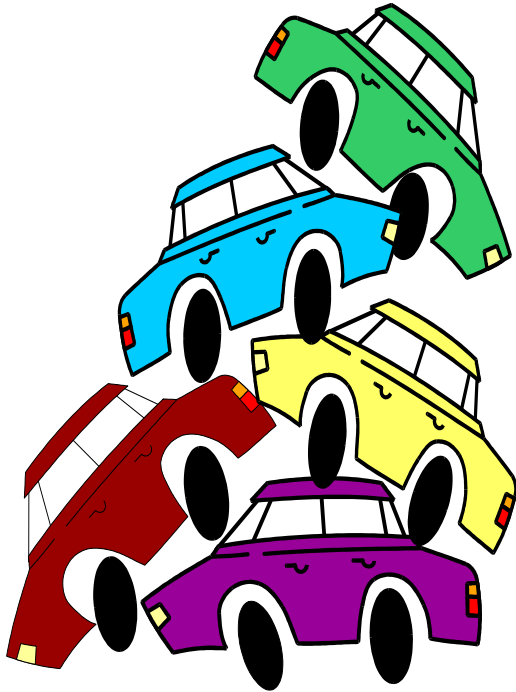
- Never hit anything head on
- Drive off the road rather than skid off
- Hit something soft before you hit something hard
- Hit something going your way before you hit something stationary
- Hit something stationary with a glancing blow
- Hit something stationary before you hit something coming toward you
- Whenever possible, steer to the right
- away from oncoming traffic

Minimize the Consequences of a Crash



- Safety technology from 1960-2000 has saved 328,551 lives
- Seat belt use rates from 1983 to 2004 have increased from 13% to 80%
- Alcohol-related fatalities have been reduced 5% from 1999-2004
- Crash fatalities are at the lowest rate recorded in history
- Manufacturers of SUVs have improved their star safety rating significantly from 2001-2005

Minimize the Consequences of a Crash



- Future improvements will continue the downward trend in lost lives in vehicle crashes
- Vehicle compatibility — reducing the difference in size between vehicle bumpers is a priority
- Roll over protection is a priority
- Vehicles with built-in crash avoidance technology is a priority

Minimize the Consequences of a Crash

- Different vehicles absorb energy in different ways and this explains why the insurance industry rates different cars at different rates
- The safer the vehicle is, due to better safety features, the better your insurance company will feel about insuring you
- Knowledge of vehicle safety will help buyers choose a vehicle with the best safety features available to keep yourself safe and insurance claims low



Lives Saved By Safety Technologies

1960 - 2002: 328,551

